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(54) **DISK BRAKE/PARKING BRAKE.**

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**FR-A- 2 348 087**  
**FR-A- 2 367 948**

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## Description

### BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates generally to disk brakes and more particularly to a disk brake which can also function as a parking brake. Such a brake is known from FR-A-2 367 948.

Disk brakes primarily comprise a rotor and a caliper. The caliper houses a piston moved by fluid (hydraulic) pressure to cause engagement of brake pads with the rotor. To achieve a parking brake function in vehicles having disk brakes, a separate brake has been required in the prior art. The only use of this separate brake is to achieve the parking brake function.

It is an object of the present invention to provide a disk brake mechanism and more particularly an improved caliper which can function as a foundation brake as well as a parking brake.

Accordingly, the invention comprises a parking brake having engaged and disengaged modes of operation comprising: a caliper, a piston movably mounted in the caliper, and a brake pad (16) movable with the piston. The caliper and piston define a fluid chamber adapted to receive pressurized fluid such through the normally used brake lines. A piston rod is movable with the piston and has a threaded portion. A nut is rotatably on the threaded portion and movable relative to a first stop. First means are provided for pressurizing the fluid chamber to move the piston and piston rod out of the caliper to a respective engaged position. Second means are also provided for rotating the nut in one of a) synchronism with pressurizing the fluid chamber and b) subsequent thereto so that the nut moves along the threaded portion into a contracting position with the first stop for preventing the piston rod from moving from its engaged position and also maintaining the brake shoes in engagement with a brake rotor.

Many other objects and purposes of the invention will be clear from the following detailed description of the drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIGURE 1 illustrates a cross-sectional view of the present invention.

FIGURE 2 illustrates another view of the present invention.

### DETAILED DESCRIPTION OF THE DRAWINGS

With reference to FIGURES 1 and 2 there is shown a disk brake/parking brake generally shown

as 10. The brake 10 comprises a caliper 12. The caliper supports a movable piston 14 which causes one or both brake pads 16 to move into friction engagement with a rotor 18. The caliper 12 and piston 14 cooperate, as is known in the art, to form a fluid chamber 20 for receipt of the fluid (typically hydraulic) through a passage 22. Extending from the caliper is a housing 24. A cover 26 is secured to the housing 24 in a known manner by bolts, welds, etc. The caliper 12 includes an opening 27 about which is positioned a fluid seal 28. A piston rod 30 extends through the seal 28 and is connected to and movable with the piston 14. The piston 14 and rod 30 may be rotatably mounted at 15 to allow for relative movement therebetween. A middle portion 40 of the piston rod 30 is helically threaded at 41. The piston rod 30 also extends through a bore 32 formed in a cylindrical portion 34 of the housing 24. A bushing 42 is provided at an end of the cylindrical portion 34 to support the piston rod 30. An end 44 of the piston rod 30 extends through the cover 26. The end 44 is hexagonally or otherwise shaped to receive a tool such as a wrench or screwdriver, the purpose of which will be clear from the description below. A radially extending portion 50 of the housing 24 supports a backing plate 52 typically fabricated of ferrous material, which extends slightly beyond a face 54 of the housing portion 50.

A nut 60 is rotatably received about the threaded portion 41 of the piston rod 30. The periphery of the nut 60 is toothed to form a spur gear 62 which is shown more clearly in FIGURE 2. A mechanical stop 64 may also be provided about the piston rod 30 at the left hand end of the threads 41.

Located in the housing 24 is a relatively low torque capacity electric motor generally shown as 66. The motor shaft (not shown) is coupled to a cylindrical elongated spur gear 68 supported at its remote end 70 by another bushing or bearing 72. The spur gear 68 drivingly engages the spur gear 62 of the nut 60. The individual teeth of the spur gear 68 extend axially along this gear 68 from the motor to the bearing 72 which enables the nut 60 may slide thereupon. FIGURE 2 also shows a cross-sectional view illustrating the interaction between the spur gears 62 and 68.

During normal brake operation hydraulic fluid is received through passage 22 to fill chamber 20, whereupon the piston 14 is moved outwardly under the pressure of the fluid causing the brake pads to move into contact with the rotor 18. During normal brake operation, the piston rod 30, nut 60, motor 66, etc. are not operative. As the piston 14 moves to the right or to the left, as shown in FIGURE 1, in response to fluid pressure spring bias (not shown) the piston rod 30 is carried with it and slides within the seal 28 and bearing 42. The nut 60 also moves

with the piston rod 30 as the teeth or spur gear 62 of the nut 60 slide along the axially extending teeth of the spur gear 68.

When it is desired to use the brake 10 as a parking brake, pressurized hydraulic fluid is supplied to the chamber 20 causing the brake pads 16 to engage the rotor sufficiently to prevent rotation of same. A fluid pressure of 1,000-1,500 psi should be sufficient. Subsequently, the motor 66 is energized by a control unit generally shown as 80 whereupon the cylindrical spur gear 68 rotates. In response to this motion, the nut 60 moves along the threads 41 into contact with the backing plate 52. The significance of this motion is as follows: with the brake pads 16 in contact with the rotor 18 the nut is moved into engagement with the housing or backing plate 52 thereby locking the piston rod 30 in a position wherein the brake pads remain in locking contact with the rotor 18 even when the fluid pressure in chamber 20 is subsequently reduced.

With reference to FIGURE 1 there is shown a pump 82 powered by another electric motor 84. The fluid chamber or brake lines, as the case may be, may be sensed by a pressure sensor generally shown as 86. The above-referenced combination of motor and pump and ECU has been disclosed in my commonly assigned, pending United States patent application assigned USSN 07/589,739, entitled "Parking Brake and Method Therefor" which is incorporated herein by reference. In response to an operator initiated signal such as by depressing a switch B (or 90) the motor is activated thereby pressurizing the fluid chamber 20 to a level of approximately 1,000-1,500 psi, which is sensed by the sensor 86 in cooperation with the ECU 80. Upon reaching this activation pressure, the brake pads 16 are moved into contacting engagement with the rotor 18. Either simultaneously or subsequent to the initiation of motor 84 operation, the ECU commands the motor 66 to rotate as described above, causing the nut 60 to move into engagement with the backing plate or stop 52. The operation of the motor 66 is terminated after the nut 60 has engaged the backing plate or stop 52. Stopping the motor 84 is accomplished by monitoring the current level in motor 66 in a known manner. It is known that the current of such a motor, i.e., motor coil 67, will increase as its load increases. Such increased load is achieved upon the engagement of the nut 60 to the backing plate 62 and its reaction force which is transferred back to the spur gear 68 and hence to the motor 66.

FIGURE 1 also shows a master cylinder 92 in fluid communication with the fluid chamber 20. The pressurization of the fluid chamber can be done manually thereby eliminating the need for the pump and motor combination. In this mode of

operation, the operator would pressurize the fluid chamber by stepping upon the brake pedal. When the master cylinder has been pressurized to the necessary pressure as sensed by the sensor 86, the ECU may thereafter illuminate a light or other indicator thereby requesting that the operator engage a button such as B (or 90) thereby activating motor 66 which moves the nut 60 into engagement with the backing plate 52.

To release the above-described brake 10 from its parking brake function additionally requires the pressurization of the fluid chamber 20. This subsequent pressurization can be done automatically upon depressing the button B (or 90) causing the motor and pump to once again pressurize the chamber 20, or alternatively, manually in a manner as described above. Upon pressurizing the fluid chamber 20, the piston 14 is urged slightly to the left as shown in FIGURE 1, thereby unloading the nut 60 from the backing plate whereupon the motor 66 is operated in a reverse manner thereby rotating the nut 60 to the left, as seen in FIGURE 1. It is only necessary to rotate or move the nut away from the backing plate a small amount so that it does not interfere with piston travel during normal brake operation. Alternatively, the nut may be moved into contact with the other stop 64 to insure the existence of a sufficient clearance between the nut 60 and backing plate 52.

As mentioned above, the extending end 44 of the piston rod 30 is formed to receive a tool such as a socket, wrench or screwdriver. The purpose of this is to provide a failure mode in the event that the motor 66 is inoperative. If the motor 66 fails, it will be impossible to automatically move the nut 60 away from the backing plate 52 to disengage the parking brake function. If this situation occurs, the piston rod 30 may be rotated manually by an operator or mechanic. As can be seen in this situation, the piston rod operates as a lead screw and as it is rotated the nut 60 will be moved from its contacting position with the backing plate thereby disengaging the parking brake function and permitting the piston to move during normal brake operation.

Many changes and modifications in the above described embodiment of the invention can, of course, be carried out without departing from the scope thereof. Accordingly, that scope is intended to be limited only by the scope of the appended claims.

#### Claims

1. A parking brake device (10) having engaged and disengaged modes of operation comprising a caliper (12), a piston (14) movably moun-

ted in the caliper (12) and a brake pad (16) movable with the piston, the caliper (12) and piston (14) defining a fluid chamber (20) adapted to receive pressurized fluid, characterized in that the brake includes:

a piston rod (30) movable with the piston (12) having a threaded portion;

a nut (60) rotatably movable on the threaded portion (40) relative to a first stop (52);

first means (80, 82, 84, 92) for pressurizing the fluid chamber (20) to move the piston (14) and piston rod (30) toward an engaged position, and

second means (66, 68) for rotating the nut (60) along the threaded portion (40) into a contacting position with the first stop for preventing the piston rod (3) from moving from its engaged position.

2. The device (10) as defined in claim 1 wherein the first means includes one of: a) a master cylinder and b) a pump (82) powered by a first motor (84) in communication with the fluid chamber (20).

3. The device as defined in Claim, 2 including third means for activating the second means when the fluid chamber is pressurized or after the chamber is pressurized.

4. The device as defined in Claim 3 wherein the second means comprises:

a second motor (66);

a first gear (68) rotated by said second motor (66); and wherein

the nut (60) includes gear teeth (62) about its periphery drivingly connected to and slidably interacting along the teeth of the first gear.

5. The device (10) as defined in Claim 4 wherein the brake (10) includes a rotor (18) contacted by the brake pad (16) when the piston rod (30) is in the engaged position.

6. The device as defined in Claim 4 wherein an end (44) of the piston rod (30), remote from the piston (14) is shaped to receive a tool such that the piston rod can be rotated manually from its engaged position in the event the first motor becomes inoperative.

7. The device as defined in Claim 6 including means for activating the first motor to pressurize the fluid chamber.

8. The device (10) as defined in Claim 4 wherein the first gear comprises a cylindrical spur gear.

9. The device (10) as defined in Claim 4 including third means for sensing that the piston rod (30) has been locked in the engaged position.

10. The device as defined in Claim 9 wherein the third means includes means for sensing an increase in current level in the second motor (66) subsequent to the nut (60) being driven against the first stop (52).

11. The device (10) as defined in Claim 10 wherein the first means is operative to pressurize the fluid chamber (20) in a manner sufficient to unstress the nut (6) from load imparted thereto by the first stop (52) when in the contacting position, and

the second means operative to rotate the nut (60) away from the first stop (52) so that the piston rod (30) is free to move with the piston (10).

12. A method using a disk brake (10) to perform a parking brake function, the disk brake (10) comprising a rotor (18), caliper piston (14) and piston rod (30) movably attached thereto, comprising the steps of:

12.1) moving the piston (14) by applying fluid pressure thereto to a first position toward a brake rotor (18) at a level sufficient to prevent rotation of the rotor by increasing pressure upstream of the piston;

12.2) securing the piston substantially in the position established by step 12.1 by causing a motor to rotate a nut (60), rotatably mounted on the piston rod (30), into contact with a stop (52).

13. The method as defined in Claim 12 including the steps of:

13.1) increasing pressure upstream of the piston to urge the nut (60) away from the stop (52) to relieve stresses therebetween and

13.2) releasing the disk brake from its parking brake function by rotating the nut away from contact with the stop.

#### Patentansprüche

1. Feststellbremsen-Vorrichtung (10), die einen Einrück- und einen Ausrück-Betriebszustand besitzt, mit

einem Bremssattel (12), einem Kolben (14), der in dem Bremssattel (12) beweglich gelagert ist, und einem Bremsbacken (16), der mit dem Kolben bewegbar ist, wobei der Bremssattel (12) und der Kolben (14) eine Strömungsmittelkammer (20) bilden, die zur

- Aufnahme eines unter Druck stehenden Strömungsmittels dient, dadurch gekennzeichnet, daß die Bremse aufweist:
- eine mit dem Kolben (12) bewegbare Kolbenstange (30) mit einem Gewindeabschnitt;
  - eine Mutter (60), die auf dem Gewindeabschnitt (40) drehbeweglich relativ zu einem ersten Anschlag (52) gelagert ist;
  - erste Mittel (80,82,84,92), die zum Druckbeaufschlagung der Strömungsmittelkammer (20) dienen, um den Kolben (14) und die Kolbenstange (30) in Richtung auf eine Einrückstellung zu bewegen, und
  - zweite Mittel (66,68), die dazu dienen, die Mutter (60) entlang des Gewindeabschnitts (40) in eine Anlagstellung mit dem ersten Anschlag zu drehen, um eine Bewegung der Kolbenstange (30) aus seiner Einrückstellung zu verhindern.
2. Vorrichtung (10) nach Anspruch 1, bei der die ersten Mittel aufweisen entweder:
    - (a) einen Hauptzylinder oder
    - (b) eine von einem ersten Motor (84) betriebene Pumpe (82) in Strömungsmittelverbindung mit der Strömungsmittelkammer (20).
  3. Vorrichtung nach Anspruch 2 mit dritten Mitteln, die dazu dienen, die zweiten Mittel zu aktivieren, wenn die Strömungsmittelkammer unter Druck gesetzt wird oder nachdem die Strömungsmittelkammer unter Druck gesetzt wurde.
  4. Vorrichtung nach Anspruch 3, bei der die zweiten Mittel aufweisen:
    - einen zweiten Motor (66);
    - ein erstes Zahnrad (68), das von dem zweiten Motor (66) gedreht wird; und bei der die Mutter (60) Zähne (62) aufweist, die mit den Zähnen des ersten Zahnrads treibend verbunden sind und entlang dieser Zähne gleitend angreifen.
  5. Vorrichtung (10) nach Anspruch 4, bei der die Bremse (10) eine Bremsscheibe (18) aufweist, an der der Bremsbacken (16) anliegt, wenn die Kolbenstange (30) ihre Einrückstellung einnimmt.
  6. Vorrichtung nach Anspruch 4, bei der ein Ende (44) der Kolbenstange (30) entfernt von dem Kolben (14) zur Aufnahme eines Werkzeugs ausgebildet ist, so daß die Kolbenstange manuell aus ihrer Einrückstellung herausgedreht werden kann, wenn der erste Motor funktionsunfähig wird.
  7. Vorrichtung nach Anspruch 6 mit Mitteln, die dazu dienen, den ersten Motor zu aktivieren, um die Strömungsmittelkammer unter Druck zu setzen.
  8. Vorrichtung (10) nach Anspruch 4, bei der das erste Zahnrad aus einem zylindrischen Stirnzahnrad besteht.
  9. Vorrichtung (10) nach Anspruch 4 mit dritten Mitteln, die dazu dienen, festzustellen, daß die Kolbenstange (30) in der Einrückstellung verriegelt wurde.
  10. Vorrichtung nach Anspruch 9, bei der die dritten Mittel Mittel enthalten, die dazu dienen, eine Erhöhung des Strompegels in dem zweiten Motor (66) im Anschluß daran, daß die Mutter (60) gegen den ersten Anschlag (52) bewegt wurde, abzufühlen.
  11. Vorrichtung (10) nach Anspruch 10, bei der die ersten Mittel in der Weise wirken, daß sie die Strömungsmittelkammer (20) ausreichend unter Druck setzen, um die Mutter (60) von der Kraft zu befreien, die von dem ersten Anschlag (52) auf sie ausgeübt wird, wenn sie sich in der Anlagstellung befindet, und die zweiten Mittel in der Weise wirken, daß sie die Mutter (60) von dem ersten Anschlag (52) wegdrehen, so daß die Kolbenstange (30) frei ist, um sich mit dem Kolben (14) zu bewegen.
  12. Verfahren unter Verwendung einer Scheibenbremse (10) zum Durchführen einer Feststellbremsfunktion, wobei die Scheibenbremse (10) eine Bremsscheibe (18), einen Bremssattel-Kolben (14) und eine beweglich daran befestigte Kolbenstange (30) aufweist, wobei das Verfahren die Schritte aufweist:
    - 12.1) der Kolben (14) wird durch Anlegen von Strömungsmitteldruck in eine erste Stellung gegen eine Bremsscheibe (18) mit einer Stärke bewegt, die ausreichend, um eine Drehung der Bremsscheibe durch eine Druckerhöhung stromauf des Kolbens zu verhindern;
    - 12.2) der Kolben wird im wesentlichen in der durch den Schritt (12.1) erreichten Stellung festgelegt, indem ein Motor veranlaßt wird, eine Mutter (60), die auf der Kolbenstange (30) drehbar gelagert ist, in Anlage mit einem Anschlag (52) zu drehen.
  13. Verfahren nach Anspruch 12 mit den Schritten:
    - 13.1) der Druck stromauf des Kolbens wird erhöht, um die Mutter (60) von dem An-

schlag (52) wegzudrücken und dadurch die dazwischen herrschenden Spannungen zu lösen, und  
 13.2) die Scheibenbremse wird aus ihrer Feststellbremsenfunktion gelöst, indem die Mutter aus ihrer Anlage an dem Anschlag gedreht wird.

### Revendications

1. Dispositif de frein de stationnement (10) fonctionnant par engagement et dégagement comprenant :

un étrier (12) , un piston (14) monté mobile dans l'étrier (12) et une plaquette de frein (16) mobile avec le piston, l'étrier (12) et le piston (14) définissant une chambre à fluide (20) prévue pour recevoir le fluide sous pression, caractérisé en ce que le frein inclut :

une tige de piston (30) mobile avec le piston (12) et présentant une partie filetée;

un écrou (60) mobile en rotation sur la partie filetée (40) par rapport à une première butée (52) ;

un premier moyen (80, 82, 84, 92 ) pour mettre sous pression la chambre de fluide (20) afin de déplacer le piston (14) et la tige de piston (30) vers une position d'engagement ,et

un second moyen (66,68 ) pour faire tourner l'écrou (60) le long de la partie filetée (40) et l'amener au contact de la première butée afin d'interdire à la tige de piston de s'éloigner de sa position d'engagement.

2. Dispositif (10) selon la revendication 1, dans lequel le premier moyen inclut l'un d'un :a) un maître cylindre et b) une pompe (82) commandé par un premier moteur (84) en communication avec la chambre de fluide (20).

3. Dispositif selon la revendication 2, incluant un troisième moyen pour actionner le deuxième moyen lorsque la chambre de fluide est mise sous pression ou après que cette chambre ait été mise sous pression.

4. Dispositif selon la revendication 3 dans lequel le second moyen comprend :

un second moteur (66) ;

un premier engrenage (68) entraîné en rotation par le dit second moteur (66) et dans lequel

l'écrou (60) inclut un engrenage droit (62) sur son pourtour relié par entraînement et conjuguant son action par coulissement le long de la denture du premier engrenage (Fig.2).

5. Dispositif (10) selon la revendication 4 dans lequel le frein (10) inclut un rotor (18) au contact de la plaquette de frein (16) lorsque la tige de piston (30) est en position d'engagement.

6. Dispositif selon la revendication 4 dans lequel une extrémité (44) de la tige de piston (30), éloignée du piston (14) est conformée pour recevoir un outil de manière à permettre de tourner manuellement la tige du piston pour la libérer de sa position d'engagement au cas où le premier moteur devient inopérant.

7. Dispositif selon la revendication 6 incluant un moyen pour activer le premier moteur à mettre sous pression la chambre de fluide.

8. Dispositif selon la revendication 4 dans lequel le premier engrenage est un engrenage droit cylindrique.

9. Dispositif (10) selon la revendication 4 incluant un troisième moyen pour détecter que la tige de piston (30) a été bloquée en position d'engagement.

10. Dispositif selon la revendication 9 dans lequel le troisième moyen inclut un moyen pour détecter une augmentation dans le niveau du courant du second moteur (66) à la suite de l'entraînement de l'écrou (60) contre la première butée (52).

11. Dispositif (10) selon la revendication 10 dans lequel le premier moyen fonctionne pour mettre sous pression la chambre de fluide (20) de manière suffisante pour soulager l'écrou (60) de la charge qui lui est imposée par la première butée (52) en position de contact, et

le second moyen fonctionne pour écarter par rotation l'écrou de la première butée (52) de telle manière que la tige de piston (30) soit libre de se déplacer avec le piston (14).

12. Méthode utilisant un frein à disque (10) pour effectuer la la fonction de frein de stationnement, le frein à disque (10) comprenant un rotor (18), le piston d'étrier (14) et une tige de piston 30 fixée de façon mobile à celui-ci, comprenant les étapes de :

1) déplacement du piston (14) en y appliquant la pression du fluide pour une première position en direction d'un rotor (18) de frein à un niveau suffisant pour interdire la rotation du rotor en augmentant la pression en amont du piston;

2) fixation du piston pratiquement dans la position obtenue par l'étape 12.1 en faisant tourner par un moteur un écrou (60), monté rotativement sur la tige de piston (30), pour l'amener au contact d'une butée (52).

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13. Méthode telle que définie dans la revendication 12 incluant les étapes de:

13.1 augmentation de la pression en amont du piston pour dégager l'écrou (60) de la butée (52) afin de les libérer des contraintes réciproques et

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13.2 desserrement du frein à disque de fonction de frein de stationnement par rotation de l'écrou pour l'amener hors de contact avec la butée.

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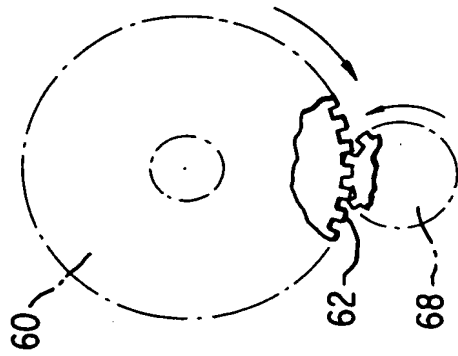


FIG. 2

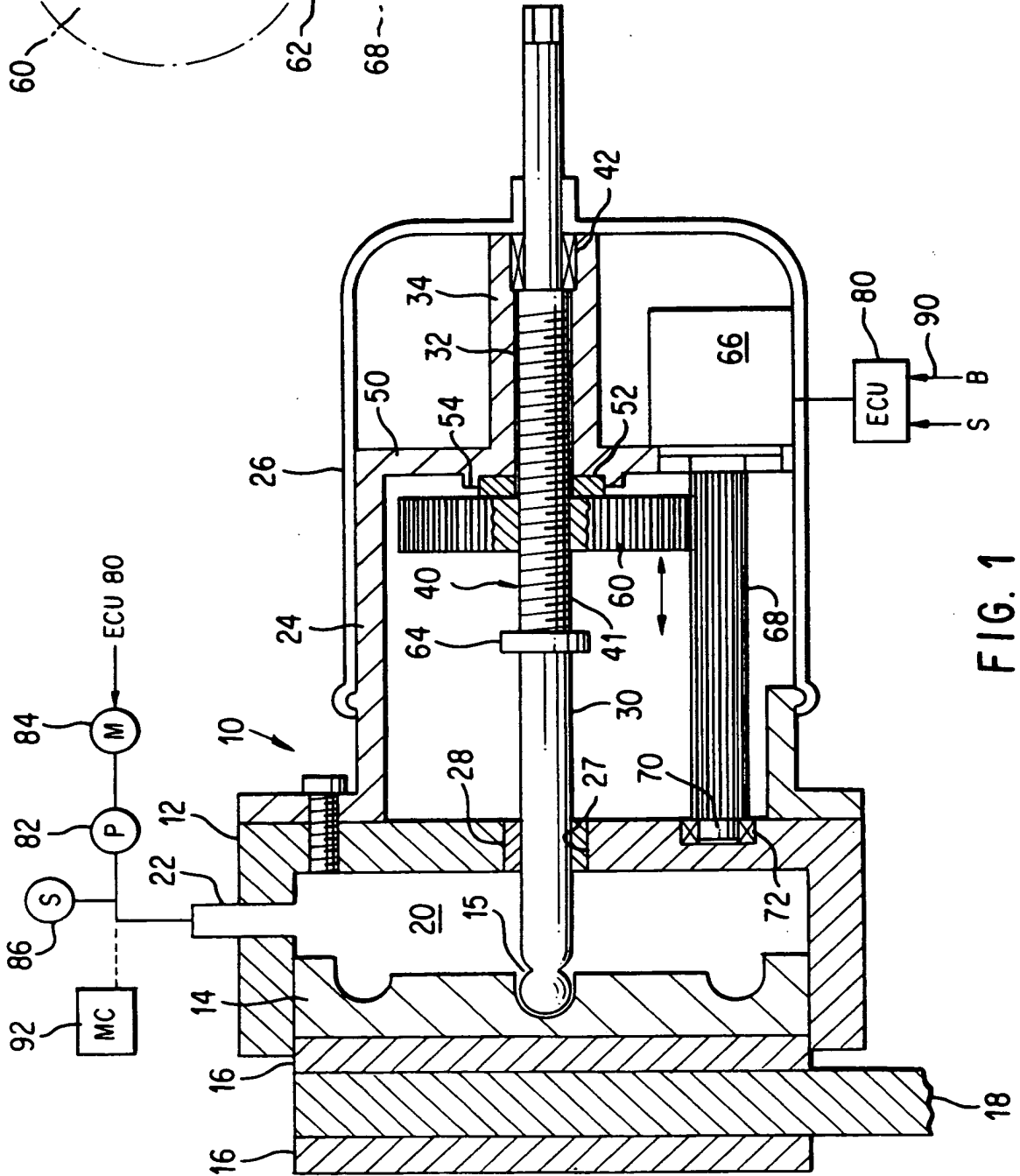


FIG. 1